GLOBE clouds

CLOUD GAZE, data merging, and the Terminator project: GLOBE Clouds in 2021

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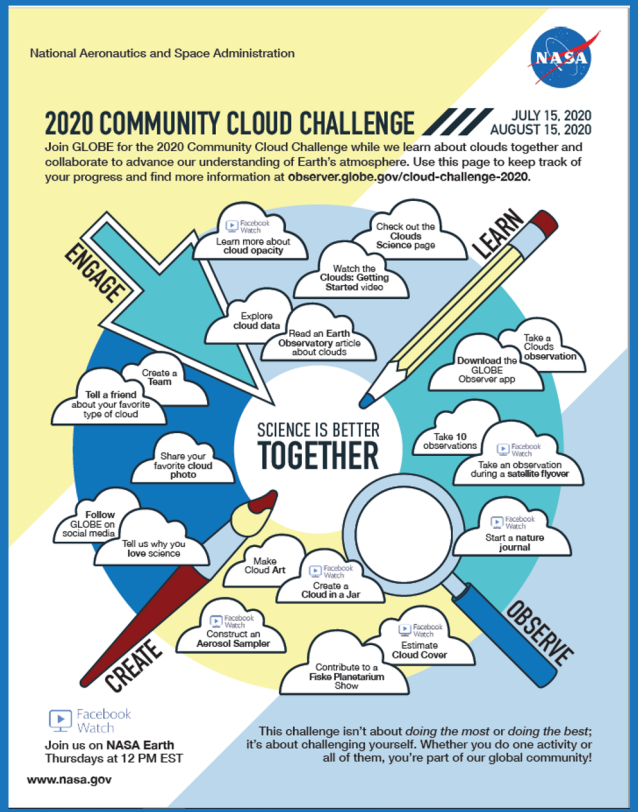
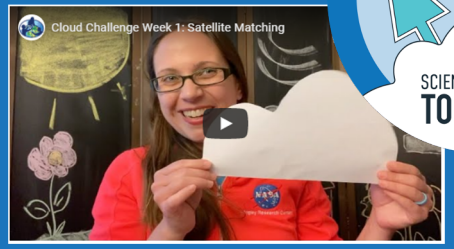
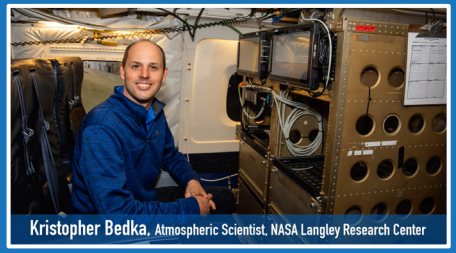
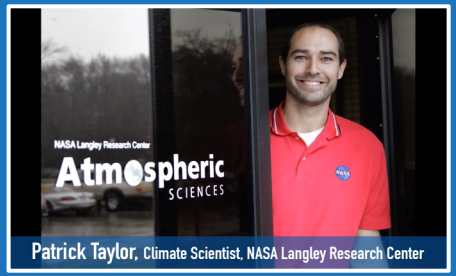
13 May 2021

2020 in Review

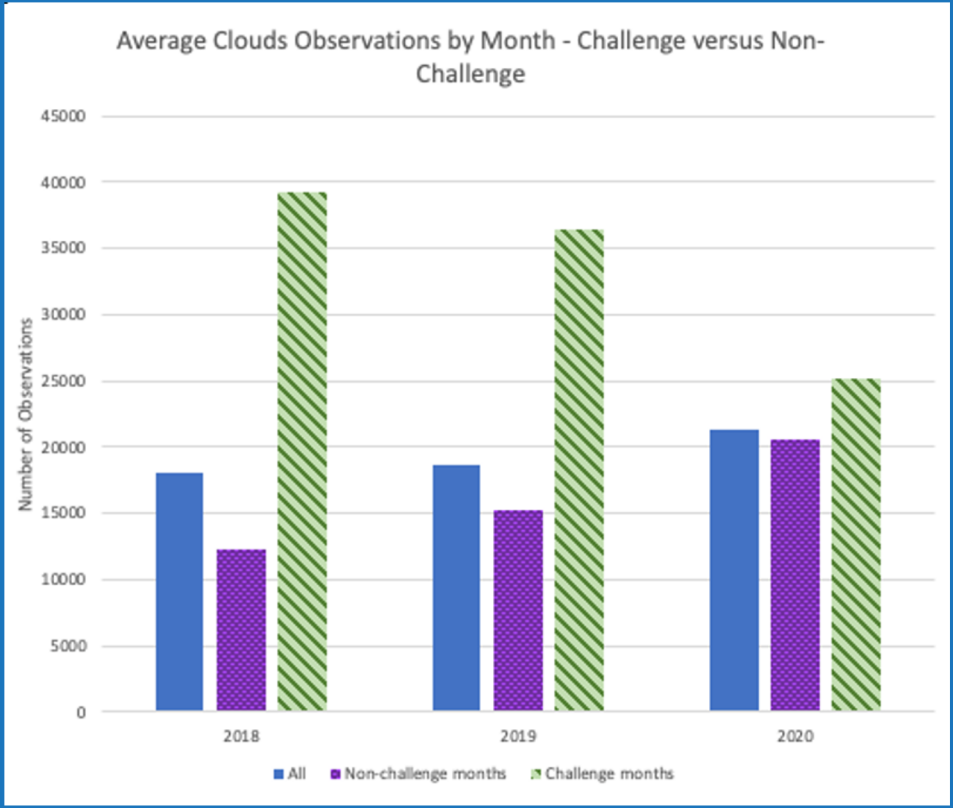








2020 in Review



Total Observations 258,888
Total Emails sent - 81,454

Satellite	Total Satellite Matches	NASA LaRC Team Support
GEO Satellite Matches • GOES 17 – 11,080 • GOES 16 – 55,620 • GOES 15 – 1,648 • Himawari-8 – 16,076 • METEOSAT-11 – 31,872 • METEOSAT-9 – 963 • METEOSAT-8 – 74,338	258,888	SatCORPS
SSF Satellite Matches • Terra – 24,974 • Aqua – 24,003	48,977	CERES FLASHFlux

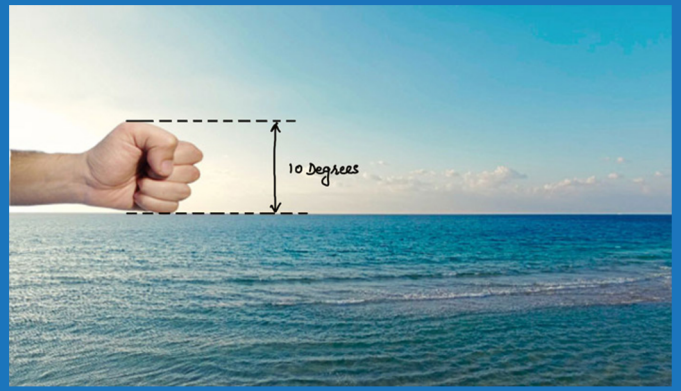
(Solar) Terminator Problem - Overview

- Satellite cloud products have performance issues near solar terminator
- Daytime retrievals use visible + IR measurements, while nighttime are IR only
- But the rapidly changing solar illumination at the terminator can confuse the retrieval algorithms
  - 3.9 µm channel is a problem
  - low clouds are frequently affected
- Citizen scientist obs. of cloud and sky conditions can be used to check satellite retrievals

Solar terminator as seen from the ISS.

(Solar) Terminator Problem - Status

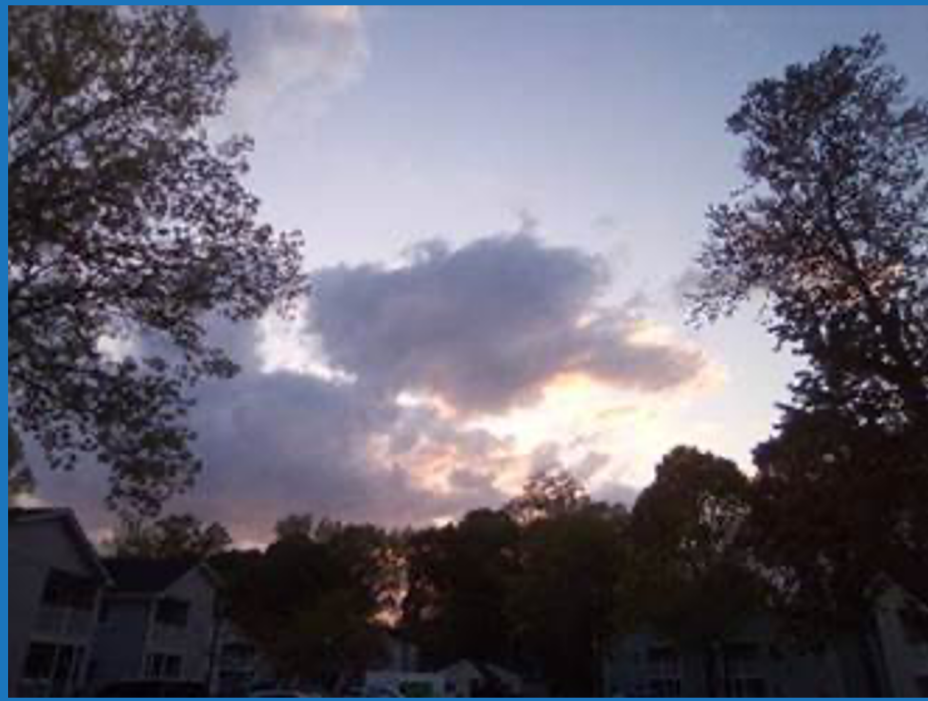
- GLOBE Clouds conducted a pilot program with NASA interns (15 March – 15 April)
- NASA interns were asked to collect observations within 1 hr of sunrise or sunset
  - when the sun was < 10° above the horizon
- The resulting 120+ observations will be used this summer for an internship research project
- *Future GLOBE Clouds projects can be designed to help address specific questions from the CERES science team*



Solar zenith angle could be estimated with a simple technique.

Locations of some of the NASA interns who collected 120 observations (3/15-4/15).

Many great photos were submitted!



Many great photos were submitted!

Merging MERRA2 with GLOBE Clouds Data - Motivation

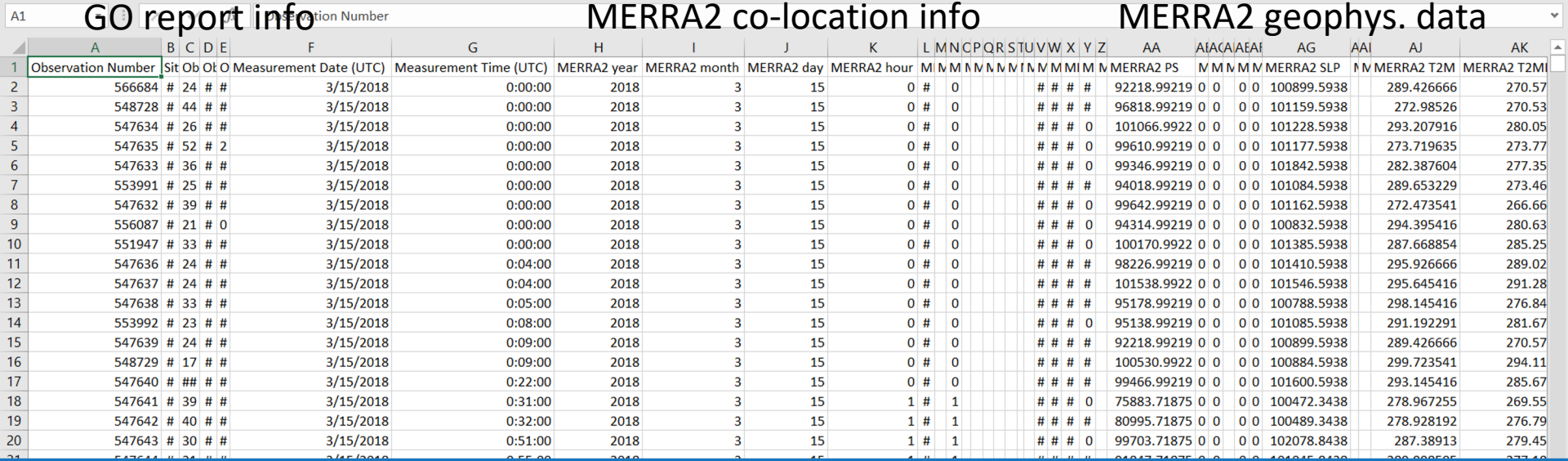
- GLOBE Clouds merges ground observer and satellite data, but currently does not include additional information about meteorological conditions
- MERRA2 is an useful source of meteorological (reanalysis) data that is synergistic with the merged ground/satellite obs.
- Possible benefits for my work:
  - contrails are sensitivity to vertical humidity profile
  - Antarctic marine haze may be sensitive to met. conditions
- Possible benefits for GLOBE Clouds:
  - having MERRA2 data merged with the existing datasets may be very useful for research projects by students, amateurs, and professional scientists alike
- Possible benefits for CERES:
  - Intercomparison studies of CERES-derived cloud properties and ground obs. will have MERRA2 thermodynamic profiles, estimated aerosol conditions, and other useful meteorological variables readily available

Example of merged GLOBE-MERRA2 data file

GO report info

MERRA2 co-location info

MERRA2 geophys. data



Observation Number	Sit	Ob	Ob	O	Measurement Date (UTC)	Measurement Time (UTC)	MERRA2 year	MERRA2 month	MERRA2 day	MERRA2 hour	M	M	M	C	P	Q	R	S	T	U	V	W	X	Y	Z	MERRA2 PS	M	M	M	M	MERRA2 SLP	M	M	MERRA2 T2M	MERRA2 T2MI
566684	#	24	#	#	3/15/2018	0:00:00	2018	3	15	0	#	0									#	#	#	#		92218.99219	0	0	0	0	100899.5938			289.426666	270.57
548728	#	44	#	#	3/15/2018	0:00:00	2018	3	15	0	#	0									#	#	#	#		96818.99219	0	0	0	0	101159.5938			272.98526	270.53
547634	#	26	#	#	3/15/2018	0:00:00	2018	3	15	0	#	0									#	#	#	0		101066.9922	0	0	0	0	101228.5938			293.207916	280.05
547635	#	52	#	2	3/15/2018	0:00:00	2018	3	15	0	#	0									#	#	#	0		99610.99219	0	0	0	0	101177.5938			273.719635	273.77
547633	#	36	#	#	3/15/2018	0:00:00	2018	3	15	0	#	0									#	#	#	0		99346.99219	0	0	0	0	101842.5938			282.387604	277.35
553991	#	25	#	#	3/15/2018	0:00:00	2018	3	15	0	#	0									#	#	#	#		94018.99219	0	0	0	0	101084.5938			289.653229	273.46
547632	#	39	#	#	3/15/2018	0:00:00	2018	3	15	0	#	0									#	#	#	0		99642.99219	0	0	0	0	101162.5938			272.473541	266.66
556087	#	21	#	0	3/15/2018	0:00:00	2018	3	15	0	#	0									#	#	#	0		94314.99219	0	0	0	0	100832.5938			294.395416	280.63
551947	#	33	#	#	3/15/2018	0:00:00	2018	3	15	0	#	0									#	#	#	0		100170.9922	0	0	0	0	101385.5938			287.668854	285.25
547636	#	24	#	#	3/15/2018	0:04:00	2018	3	15	0	#	0									#	#	#	#		98226.99219	0	0	0	0	101410.5938			295.926666	289.02
547637	#	24	#	#	3/15/2018	0:04:00	2018	3	15	0	#	0									#	#	#	#		101538.9922	0	0	0	0	101546.5938			295.645416	291.28
547638	#	33	#	#	3/15/2018	0:05:00	2018	3	15	0	#	0									#	#	#	#		95178.99219	0	0	0	0	100788.5938			298.145416	276.84
553992	#	23	#	#	3/15/2018	0:08:00	2018	3	15	0	#	0									#	#	#	0		95138.99219	0	0	0	0	101085.5938			291.192291	281.67
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548729	#	17	#	#	3/15/2018	0:09:00	2018	3	15	0	#	0									#	#	#	#		100530.9922	0	0	0	0	100884.5938			299.723541	294.11
547640	#	##	#	#	3/15/2018	0:22:00	2018	3	15	0	#	0									#	#	#	#		99466.99219	0	0	0	0	101600.5938			293.145416	285.67
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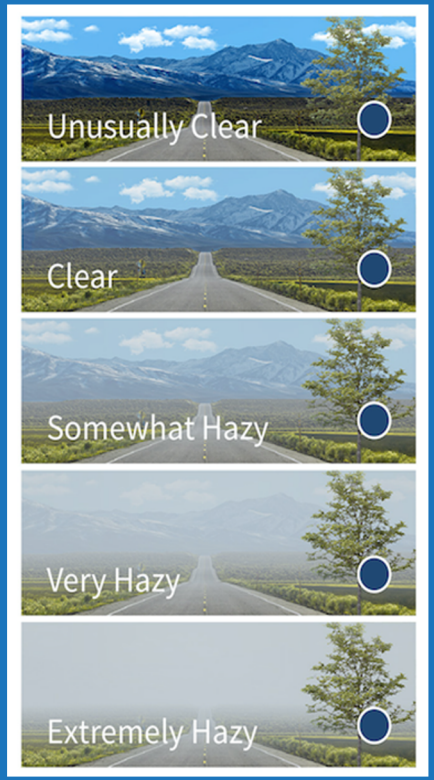
547642	#	40	#	#	3/15/2018	0:32:00	2018	3	15	1	#	1									#	#	#	#		80995.71875	0	0	0	0	100489.3438			278.928192	276.79
547643	#	30	#	#	3/15/2018	0:51:00	2018	3	15	1	#	1									#	#	#	0		99703.71875	0	0	0	0	102078.8438			287.38913	279.45

- MERRA2 data are merged with the data files for the Spring Cloud Challenge 2018, Fall Cloud Challenge 2019, and Community Cloud Challenge 2020
- Data are co-located by lat/lon and time
- *This is an experimental dataset for the time being*

EX study: GLOBE sky color and vis. vs. MERRA2 aerosol properties

sky color values

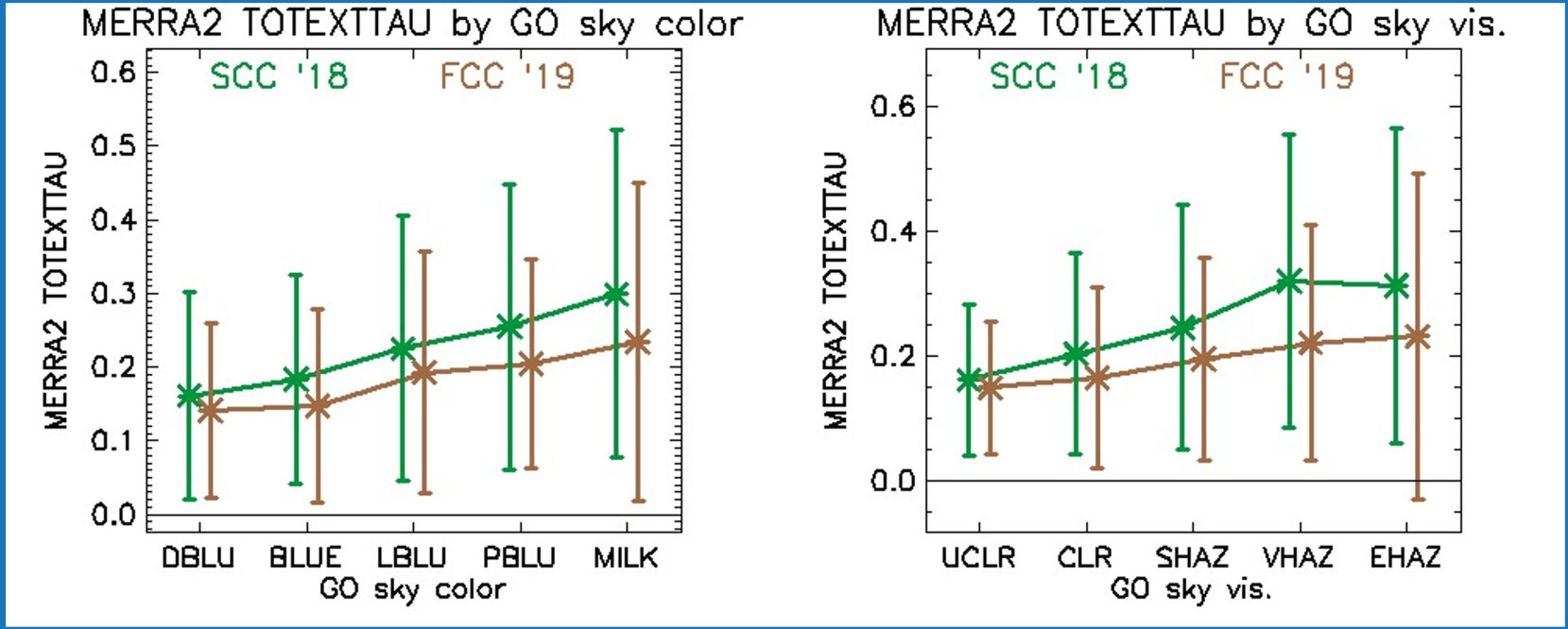


sky visibility values

- Question: How can GLOBE/MERRA2 merged data be used?
- GLOBE collects reports on sky color and visibility, metrics of atmospheric turbidity (and air quality)
- MERRA2 provides aerosol properties related to turbidity
- Is there a relationship between GLOBE and MERRA2 variables?

EX study: GLOBE sky color and vis. vs. MERRA2 aerosol properties

TOTEXTTAU = Aerosol Optical Depth (extinction)



These results show the potential of research using joint GLOBE-MERRA2 datasets

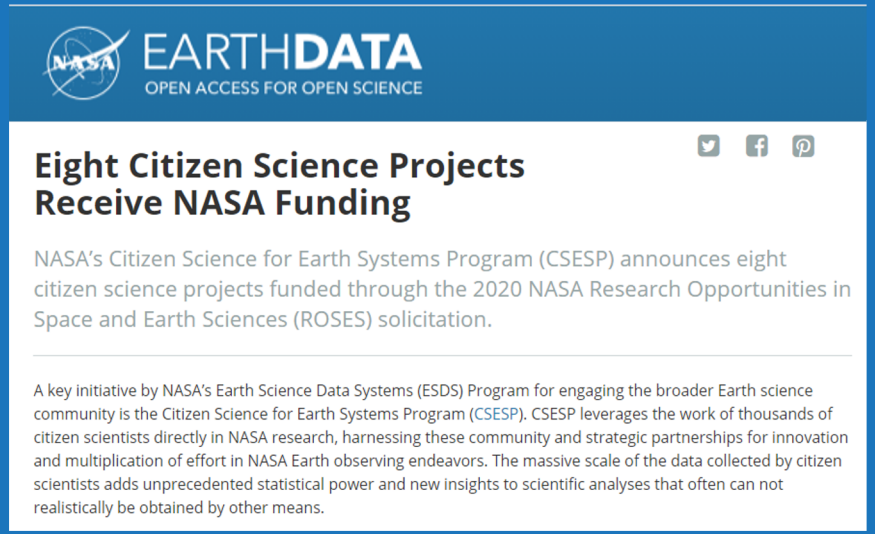
New Proposal Award: CLOUD GAZE

The CLOUD GAZE project will be a major step in the effort to improve the data quality of GLOBE Clouds reports

Community science project Leveraging Online and User Data through GLOBE And Zooniverse Engagement

GLOBE Clouds will partner with Zooniverse to facilitate this project

- previous successful Zooniverse projects of this type include Galaxy Zoo, etc.



CLOUD GAZE is funded by ROSES A.41 as a Type 1 proposal: Citizen Science Research gathering new data.

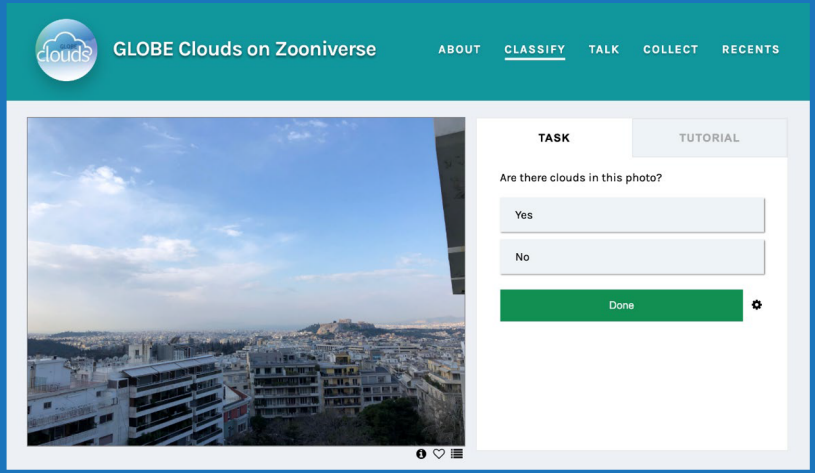
CLOUD GAZE: Methodology

GLOBE Clouds has collected over 300K photographs of sky conditions at part of GLOBE Observer reports

The results will be compared with satellite comparisons and ground reports.

Develop metadata and data quality flags.

Photographs taken by GLOBE Clouds citizen scientist.

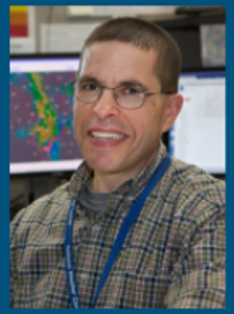


Example view of Zooniverse mockup of CLOUD GAZE.

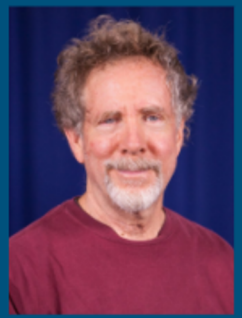
CLOUD GAZE Science Steering Committee

Kris Bedka
(LaRC)

David Painemal
(LaRC/SSAI)



Stephen Corfidi
(NOAA/NSSL)



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(backup) MERRA2 Overview

- Built from GEOS-5, with assimilated satellite and *in situ* data
- 10 types of datasets
  - met. variables (temperature, humidity, wind, etc.) (2D and 3D)
  - aerosol properties (2D and 3D)
  - surface fluxes
  - radiative fluxes
  - land surface properties
- 0.625°×0.5° horizontal resolution
- 72 vertical levels
- 1 hr (2D) and 3 hr (3D) time resolution
- Data available from 1980-(near) present